

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Applicants:** Chu Yong Cheng and Mark Daniel Ubani      **Examiner:** Stalder, Melissa A

**Serial No.:** 10/588,116      **Art Unit:** 1732

**Filed:** June 19, 2007      **Docket:** 03164.0205USWO

**For:** Solvent Extraction Process for Separating Cobalt and/or Nickel from Impurities in Leach Solutions

**Confirmation No.:** 3811

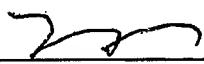
Commissioner for  
Patents  
P.O. Box 1450  
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**DECLARATION OF DR. ZHAOWU ZHU**

I, Zhaowu Zhu, hereby declare as follows:

1. I am a Research Scientist at CSIRO, the assignee of the above-identified application.
2. I hold a Bachelor of Science majoring in Chemistry and Chemical Engineering, a Masters in Solid State Material Chemistry and a Doctorate degree obtained for research in the solvent extraction field. A true and correct copy of my *curriculum vitae* is attached hereto as **Exhibit 1** of this Declaration.
3. I have conducted extensive research in the field of solvent extraction. Before joining CSIRO in 2007, I was Associate Professor of General Research at the Institute Non-ferrous Metals (herein referred to as "GRINM") and the Deputy Director of the Fine Chemical Department of GRINM. The focus of my research was rare earth separation and purification by solvent extraction. Prior to holding that position, I was completing my doctorate at the China Institute of Atomic Energy, working on the separation of actinides by solvent extraction.
4. At the time the invention described in US patent application No. 10/588116 was first filed, I held the position of Associate Professor of General Research at GRINM and was the Deputy Director of the Fine Chemical Department of GRINM in China.
5. I have read and understood the invention described in US patent application No. 10/588116.
6. I have read the Final Office Action dated 7 June 2010, which was issued by the USPTO.

7. I have read and understood each of the prior art documents cited by the US Examiner, namely GB 2109357 (herein referred to as "Preston"), WO 02/22896 (herein referred to as "Cheng") and US 5447552 (herein referred to as "Mihaylov").
8. From reading each of Preston, Cheng and Mihaylov, I would not have combined Mihaylov with either Preston or Cheng.
9. Preston relates to a solvent extraction process which uses an extractant containing a carboxylic acid and a non-chelating oxime or an extractant containing an organophosphorus acid extractant with non-chelating oximes.
10. Cheng relates to a solvent extraction process which uses an extractant containing a carboxylic acid and a synergist, which may be a non-chelating oxime.
11. Mihaylov relates to a solvent extraction process using an extractant containing at least one organic soluble dithiophosphinic acid. Mihaylov mentions, in the description of the background art of the invention (column 3, lines 8-12), that tri-butyl-phosphate (TBP) can be used with organothiophosphorus extractants as an oxygen donor reagent to prevent formation of cobalt III by oxidation of cobalt II. This disclosure is specific to solvent extraction processes using an organothiophosphinic extractant, and does not instruct me to use oxygen donor reagents in any other solvent systems. Based on my knowledge and experience of solvent extraction technology, I do not consider that this disclosure in Mihaylov can be combined with the process in Preston or Cheng.
12. The way that the Examiner has combined Preston with Mihaylov and Cheng with Mihaylov suggests that the Examiner is of the opinion that you can simply combine any reagents to prepare a suitable solvent extractant for performing a desired extraction. This is not the case. Because of the lack of predictability as to how metals will be partitioned when extraction reagents are combined, it is not the practice of experts in this field, including myself, to combine documents like Mihaylov with other documents like Preston or Cheng.
13. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that those statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such wilful false statements may jeopardize the validity of this application or any patent issuing thereon.

By: 

Dated: 24/12/2010

# CURRICULUM VITAE OF DR ZHAOWU ZHU

## CURRENT POSITION

- ❖ 2007-present, Research Scientist, CSIRO Process Science and Engineering, Australia.

## EMPLOYMENT HISTORY

- ❖ 2003-2007, Associate Professor of General Research Institute Non-ferrous Metals (GRINM) and Deputy Director of Fine Chemical Department of GRINM, main research area: rare earth separation and purification by solvent extraction
- ❖ 1995-2000: China Institute of Atomic Energy (CIAE), Beijing China.

## EDUCATION AND QUALIFICATIONS

- 2000 – 2003: Ph.D. China Institute of Atomic Energy (CIAE), Beijing China. Research area: Actinides separation by solvent extraction,
- 1992 – 1995: M.S. Beijing University, Beijing, China. Research area: Solid state material chemistry,
- 1986 – 1990: B.S. Shandong Education College, Shandong, China. Major in: chemistry and chemical engineering,

## SELECTED PUBLICATIONS

1. Wang Lianbo, Zhu Zhaowu, Yang Mei, et al., Synthesis and Characterization of  $\beta$ -Zeolite from Aluminosilicate Sol Containing Fluorion. *Chinese Acta Petrolei Science (Petroleum Processing Section)*. 1999, 15(2):23-28.
2. Zhu Zhaowu, Hu Jingxin, Ye Guoan, Distribution of U(VI) in Dilute TBP/kerosene-HNO<sub>3</sub> solution. *Chinese Journal of Nuclear and Radiochemistry*. 2000, 22(3):166-172.
3. Zhu Zhaowu, Zhang Zefu, Li Guanghua, et al., The Determination of <sup>237</sup>Np in the Large Amount of Uranium Solution by  $\gamma$ -Spectrum. *Chinese Atomic Energy Science and Technology*. 2001, 35(6): 538-541.
4. Zhu Zhaowu, He Jianyu, Zhang Zefu, et al., Steady-State Method to Calculate and Analyze U/Pu Separation Technique in Purex Process. *Chinese Atomic Energy Science and Technology*, 2003, 37(5):422-427.
5. Zhang ZF, He JY, Zhu ZW, et al., Neptunium Control in Co-decontamination Step of Purex Process. *Journal Fuel Cycle and Environment*. 2002, vol.8, No2.
6. Zhu Zhaowu, He Jianyu, Zhang Zefu, Zhao Zhiqiang, Generation of Nitrous Acid by Bubbling NO in Nitric Acid Solutions and Its Application for Puex Process. *Journal of Radioanalytical and Nuclear Chemistry*. 2003, 258(3):557-561.
7. Zhu Zhaowu, Hu Jingxin, Zheng Weifang, et al., U (VI) Distribution in Dilute TBP/kerosene Under the Salting out Effect of Aluminium nitrate. *Chinese journal of Nuclear and Radiochemistry*, 2003, 25(4):193-198.
8. Zhu Zhaowu, He Jianyu, Zhang Zefu, et al. Kinetics of hydroxyurea reducing nitrous acid and its application in stabilizing Pu( $\square$ ). *Chinese journal of Nuclear and Radiochemistry*, 2004, 26(1):1-5.
9. Zhu Zhaowu, He Jianyu, Zhang Zefu, et al., Kinetics of the Reduction of Plutonium(IV) by Hydroxyurea, a Novel Salt-Free Agent. *Journal of*

- Radioanalytical and Nuclear Chemistry*. 2004, 260(3):585-590.
- 10. **Zhu Zhaowu**, He Jianyu, Zhang Zefu, et al., Pu(IV) reduction with hydroxyurea and its application in U/Pu separation. *Chinese Atomic Energy Science and Technology*. 2004, 38(6), 538-541.
  - 11. **Zhu Zhaowu**, He Jianyu, Zhang Zefu, et al., Uranium/Plutonium and Uranium/Plutonium Separation in the 1B Contactor of PUREX with Hydroxyurea. *Jurnal of Radioanalytical and Nuclear Chemistry*. 2004, 262(3):707-711.
  - 12. **Zhu Zhaowu**, Long Zhiqi, Cui Dali, et al., Preparation of fine spherical particle sized ceria by precipitation method with ammonium bicarbonate. *Journal of Rare Earths*, 2005, 23(1):81-84.
  - 13. **Zhu Zhaowu**, Long Zhiqi, Cui Dali, et al., Preparation of superfine particle of ceria and its UV absorption character. *The Chinese Journal of Nonferrous Metals*. 2005, 15(3): 435-440.
  - 14. **Zhu Zhaowu**, Zhao Na, Long Zhiqi, et al., New Environment-Friendly Approach for Bastnasite Treatment(I): Extraction of Tetravalent Cerium from Sulfuric Acid Medium with Di(2-ethylhexyl) Phosphoric Acid. *Journal of Rare Earths*, 2005, 23(2):178-182.
  - 15. Li Janning, Huang Xiaowei, **Zhu Zhaowu**, et al., Extracting Rare Earth from D2EHPA-HEHEHP-H<sub>2</sub>SO<sub>4</sub> System. *Journal of Chinese Rare Earth Society*, 2007, 25(1): 55-58.
  - 16. Long Zhiqi, Ren Le, **Zhu Zhaowu**, et al., Synthese of LaPO<sub>4</sub>:Ce, Terbium by Coprecipitation Method. *Journal of Rare Earths*, 2006, 24(spe.), 137-140.
  - 17. Peng Xinlin, Zhao Na, **Zhu Zhaowu**, et al., Electrical Conductivity and FT-IR Spectrum of MicroemulsionH EHEHP Saponified with Ammonia. *Chinese Journal of Rare Metals*, 2006, 30(4), 480-483.
  - 18. Cheng, C. Y., **Zhu, Z** and W. Zhang, 2009. A DSX process to recover copper, nickel, cobalt and zinc from chloride solutions by synergistic solvent extraction. *ALTA Copper*, Perth Australia, May 2009.
  - 19. Cheng, C.Y., Boddy, G., Zhang, W., Godfrey, M., Robinson, D.J., Pranolo, Y., **Zhu, Z.** and Wang, W., 2010. Recovery of nickel and cobalt from laterite leach solutions using direct solvent extraction: Part 1 – selection of a synergistic SX system. *Hydrometallurgy*, 104: 45-52.
  - 20. Cheng, C.Y., Boddy, G., Zhang, W., Godfrey, M., Robinson, D.J., Pranolo, Y., **Zhu, Z.**, Zeng, L. and Wang, W., 2010. Recovery of nickel and cobalt from laterite leach solutions using direct solvent extraction: Part 2 – semi - and fully - continuous tests. *Hydrometallurgy*, 104:53-60.
  - 21. **Zhu, Z.**, Pranolo, Y., Zhang, W., Wang, W. and Cheng, C.Y., 2010. Precipitation of impurities from synthetic laterite leach solutions. *Hydrometallurgy*, 104:81-85.
  - 22. **Zhu, Z.**, Pranolo, Y., Zhang, W. and Cheng, C.Y., 2010. Flowsheet for the separation of cobalt and zinc from concentrated nickel sulphate solutions with Cyanex 272. *Journal of Chemical Technology and Biotechnology* (In press)
  - 23. **Zhu, Z.**, Zhang, W. and Cheng, C.Y., 2010. A Literature Review of Titanium Solvent Extraction in Chloride Media. *Hydrometallurgy*. 2011 in press.
  - 24. **Zhaowu Zhu** and Chu Yong Cheng, Solvent Extraction Technology for the Separation and Purification of Niobium and Tantalum: A Review. *Hydrometallurgy*. 2011 in press.

## PATENTS

1. **Zhu Zhaowu**, He Jianyu, Zhang Zepu, et al., A Novel method to separate uranium and plutonium in PUREX process. Chinese patent, CN1472347, 2002. Granted.
2. **Zhu Zhaowu**, Long Zhiqi, Huang Xiaowei, et al., A method to remove fluorine from loaded organic phase after extracting from bastnasite leaching solution. CN1648264, 2004. Granted.
3. **Zhu Zhaowu**, Han Yebin, Long Zhiqi, et al., UV absorption material of ceria modified by fluorine ion and its applications. 200710064522.8.
4. **Zhu Zhaowu**, Huang Xiaowei, Li Hongwei, et al., Flame Retardant of Rare Earth-Magnesium Hydroxy composite and its preparation. 200710163320.9.
5. **Zhu, Z.**, Cheng, C. Y. and Zhang, W., 2009. Extraction of copper and /or nickel and other metals from chloride solutions by solvent extraction. *Australian Provisional Patent No. 2009901624*.
6. **Zhu, Z.**, Cheng, C. Y. and Zhang, W., 2009. Separation of cobalt, zinc and nickel in chloride solutions by solvent extraction. *Australian Provisional Patent No. 2009901623*.
7. Cheng, C. Y., **Zhu, Z.** and Zhang, W., 2009. A solvent extraction process for the separation of copper from iron in chloride solutions. *Australian Provisional Patent No. 2009903004*.
8. **Zhu, Z.**, Cheng, C. Y., Zhang, W., Wang, W., Pranolo, Y., 2010. A process for recovering niobium and/or tantalum using solvent extraction. *Australian Provisional Patent (TW8428)*.